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The Agricultural Student



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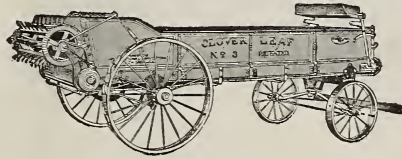
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No. 9

THE LIMITING FACTORS IN CHOP PRODUCTION

By Firmen E. Bear, '08, Instructor in Agricultural Chemistry

In the growing of every crop there is always some limiting factor which determines the amount which will be produced. A farmer's success is measured by his ability to eliminate these factors, whatever they may be, in crop production, that prevent him from realizing the maximum yield. Production is often limited long before the amount produced is sufficient to pay for the labor and capital invested. Some place between maximum and minimum yield lies the line where the cost of production and the value of the product are equal. All above this line is profit, all below, loss. The average crops of the United States lie below this line. It is generally agreed that twenty-five bushels of corn per acre (the average crop) is not profitable. The average yield of wheat is thirteen bushels and even at its present selling price the farmer cannot afford to grow it for the market unless he produces more than average crops. The average of all farm crops falls very low when compared to the yields realized here and there under favorable conditions. One hundred bushels of corn have been produced on an acre of soil and fifty bushels of wheat is not impossible, but these have been grown only in rather exceptional cases. They serve to show what is possible, however, and the nearer the farmer approaches the maximum, the

farther removed he is from the line where the cost of production and the value of the product are equal. It is for him to determine what it is in his soil or in his method of farming that is the limiting factor and then proceed to eliminate it. As a rule no one factor is responsible for unprofitable yields. As each succeeding factor is removed the yield increases. The distance the water will flow depends on how many of the water gates are opened, and the flow will never reach the end of the ditch unless all obstacles are removed. To carry the comparison farther, in the ditch we are able to see just how far the water has gone and what prevents its going farther. In the case of the crop the farmer is able to see how much has been produced, but he is not always so certain as to what prevents a greater yield being realized. The difference then, between the farmer whose acres yield for him the maximum crops and the farmer who is content with the minimum is one of ability to see and remove the limiting factors. How can a man be content to grow average crops when the possibilities are shown him by his neighbor? But many farmers are evidently content or they would not let themselves fall into the class of minimum producers.

The factors which limit crop production may well be classified into biological,

meteorological, physical and chemical. These factors may be either positive or negative. By that is meant there may be too much or not enough of anything. Water may be an essential to plant growth, but plants cannot grow under water. One can get too much of a good thing for it ceases to be a good thing when he gets too much of it. The factors will be discussed in the order named.

Biological: To discuss fully the biological factors which enter into crop production would require a botanist, an entomologist, a bacteriologist and perhaps a zoologist. They will be discussed here in only a general way.

The botanist could point out any number of limiting factors and suggest methods of control. He might mention the rusts, smuts, mildews, potato scab, peach yellows, and all kinds of fungus diseases and the means of controlling them. He might suggest to you the possibilities of plant selection, plant breeding, methods of growing larger and better ears of corn, more grains of wheat in a head, new and better varieties of fruit. Anything which will enable one to produce a larger or more valuable crop must of necessity remove some factor which prevented him from doing it before. Many varieties of weeds are active factors in limiting crop production. Cheat, thistles, buckthorn, cockle, wild garlic and wild carrots are among the weed pests with which the farmer has to contend, yet an intelligent application of the best methods of cultivation and rotation will enable him to control these factors.

Much depends on one's ability to make the conditions for bacteria favorable in the soil as to the amount of available plant food there will be for any given crop. As men study the problem they are becoming more and more convinced

that bacteria are very important factors in soil fertility. Any method of tillage, drainage, fallowing or manuring which increases the bacterial content of the soil in favorable bacteria aids in crop production. In manures much depends on the method of control of the manure pile as to what kind of bacteria will effect decomposition of the manure and consequently what the value of the manure will be when applied. After it has been applied the tillage methods practiced and the physical condition of the soil will determine how readily this or any other organic matter will be converted into available plant food by the soil bacteria. On the other hand, poor drainage and improper cultivation methods have for their effects, insufficient aeration, the consequent production of denitrifying bacteria, and the elimination of those bacteria favorable to best results. The legume bacteria, the most important to the farmer, can best exist in soils well aerated and not acid in character. Anything which the farmer can do to increase the number of favorable bacteria and decrease the destructive forms, lends a hand to the increasing of crops. Anything which tends to aerate the soil, warm it, and supply it with organic matter aids in increasing the number of favorable soil bacteria. These not only effect the decomposition of the organic matter of the soil, but also make slowly available the inorganic food constituents of the soil.

The entomologist points out the insects which are destructive or beneficial to plant growth. When America was as yet a new continent nature was lavish in the production of crops. Maximum yields were obtained with but little labor on the part of the early settlers. The crops of grain and fruit yielded by the virgin soil were all that any one could desire. Any new land is naturally pro-

ductive and usually free from destructive insects, but as man appears on the scene, determines what crop or crops are most favorable for him and for the soil and climate, and commences growing them he finds sooner or later that a new factor has entered into crop production. That factor is the entomological factor. These insects may or may not have been present in that locality previous to this time.

But whether they were introduced or were originally present, as soon as any one crop is produced to the exclusion of others, the insects which have as their host that species of plants increase in numbers and in destructive ability. This has been found true in many cases. The Colorado potato beetle was never heard of until they began producing potatoes to the exclusion of other crops. This beetle



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found them to his liking and rapidly increased in numbers and in destructiveness. The Hessian fly, the cotton boll weevil, grasshoppers, cutworms and many more of these pests have rapidly increased under conditions where only their host plant was grown. Driven to despair, farmers have looked for some remedy and usually the one most productive of results has been found to be a system of crop rotation. Once adopted they find it is not only of use in the controlling of insects and destroying weeds, but it enables them more successfully to maintain the crop producing power of the soil. Rotation of crops makes it possible to increase the nitrogen content of the soil most economically and is beneficial in many other ways. Usually farmers are forced to adopt it by their friends, as well as enemies, the insects.

The zoological factor has to do with rodents, birds and toads. Some destructive, some helpful, it is worth our while to make a study of them. It has been the nature of man to be master and he seems not content until he has destroyed all other animals which come in his way. We fail to appreciate the benefits to be derived from birds and toads and class them all as destructive. The numbers of insects killed by them each year is enormous. We should not fail to appreciate their aid in removing some of the factors which limit the yield of crops.

Meteorological: It is not possible, evidently, for the farmer to do anything which will increase or decrease the amount of rainfall at any particular season, or to say how much sunshine or cold weather there may be. It may rain today or next week, the sun may shine tomorrow or a cold wave with a cloudy sky may be the weather conditions. But the farmer can assist in warming the soil and in retaining the moisture that has

fallen, to tide the crop over the seasons of cold and drouth.

Physical: Drainage, tillage, and the presence or absence of organic matter are the physical factors which are of the most importance in farming. The physical condition of the soil is largely responsible for many poor yields. Any operation which tends to aerate the soil will improve clay soils. The factors which are active in improving physical condition of clay soils are usually as effective in other soils. Drainage increases the space for root development. Tillage aerates the soil. Humus, besides being a store of plant food in itself, has the property of improving the physical condition of any soil. Maximum crops cannot be grown in its absence. It is the presence of organic matter in the manure that is responsible for its being a better fertilizing agent than commercial fertilizers.

Chemical: As a rule the only chemical limiting factors are water and the elements calcium, nitrogen, potassium and phosphorus. It is true that in certain instances minerals are injurious to plant growth. As mentioned before, limiting factors may be either positive or negative. Poorly drained soils often contain ferrous iron and other compounds which are injurious to plants. In some of the arid sections the supply of alkali carbonates and chlorides is over abundant and fall under the class of positive limiting factors. With most farmers it is only a problem of maintaining the supply of water, lime, nitrogen, potash and phosphoric acid, as the negative limiting chemical factors in crop production. The first named may also be over-abundant in which case drainage, of course, is necessary. Or it may be insufficient and tillage operations are important in this connection. It is

probably true that water is more often the limiting factor than any other thing. It is not possible to control the supply of rainfall but only to best utilize it and prevent as far as possible its being a limiting factor.

Soils vary much in their chemical composition depending on their origin. If they have been derived from limestone the supply is usually sufficient. But even here, after years of cropping there is a tendency for the lime to be washed away and the soil to become acid, because of the organic acids formed in plant decomposition. Inability to grow clover and the appearance of sorrels are indications of soil acidity. Lime is necessary to neutralize the acidity and consequently will be the limiting factor until applied.

The supply of nitrogen is important to the farmer for two reasons. It is the most easily lost by leaching and is the most expensive to buy. The introduction of legumes in crop rotation helps materially to remove it from the list of limiting factors. This has been found especially true where a legume occurs as often as once every third year. This, together with the economical management of barnyard manure, will do much toward supplying sufficient nitrogen for the crops.

Certain soils are very deficient in potash. Most soils have more available potash than they have of either lime or phosphoric acid. In sandy soils and in organic soils potash is most likely to be a limiting factor. Usually, however, an application of readily available potash salts increases the yield.

The most important single element, the one most often lacking and conse-

quently limiting the yield, is phosphorus. Not being very plentiful in any soil the supply is soon reduced until profitable crops can no longer be grown without its application. Any system of farming, unless it be that of dairying removes considerable quantities of phosphorus from the soil. If the grain crops are sold the farmer is selling at the same time a certain number of pounds of phosphorus. If the grain is fed to animals and they are sold from the farm, he loses the phosphorus of the bones, which are composed almost entirely of calcium phosphate. In either case he is selling a considerable more phosphorus than he is of either potash or lime. There is no way of artificially increasing the supply except by the use of phosphate fertilizers. The Ohio Experiment Station and its substations have shown that a greater increase per amount of money invested, no matter what the crop may be, has resulted from the application of phosphorus than that of any other element. This means then that of these chemical elements the one which prevents most often the production of profitable yields is phosphorus.

To recapitulate, then, successful farming means that a man must study the conditions which govern his own farm, must endeavor to learn what in his particular case limits the yield of his crops. Having determined this he can more successfully eliminate the factors which prevent him from reaping maximum crops. The ability to determine what the limiting factors are, marks the difference between the farmer who simply "makes a living," and the farmer who "enjoys an income."

SOURCES OF BACTERIA IN MILK

By G. E. Boltz, '10

It has long been known that pure milk secreted from a healthy cow, contains no bacteria, and that all bacterial contamination of the milk comes from external sources. While this fact has been redemonstrated by the most recent work, it has appeared that the statement must be, for practical purposes, considerably modified. In the first place the difficulties which lie in the way of obtaining milk from the cow without bacterial contamination, are extremely great and almost insurmountable. Of the many attempts that have been made to obtain sterile milk in this way, most have proved failures; but enough of them have met with success to demonstrate the fact that milk, when secreted by a healthy cow, is sterile. In spite of the cleanly methods, of sterilized vessels, and of the greatest care to prevent dirt and dust from getting into the milk, the milk, when first drawn from the cow, has in the large majority of cases contained bacteria. The explanation of this fact is that the milk duct is open to the air, and will contain at the close of milking a considerable amount of milk adhering to its wall. Bacteria from the air enter the duct, grow and multiply with great rapidity in the residual milk, and the result is that by the time of the next milking the milk ducts contain bacteria in great numbers, and these in turn will contaminate the milk. Hence this may be called the first source of bacteria in the milk of a healthy cow.

When the udder of a cow is diseased it is certain that the milk may be contaminated even when secreted. It has long been known that when a cow has tuberculosis in the udder her milk is almost certain to contain tuberculosis

bacilli. It is also equally true that inflamed udders infect the milk with bacteria. When the udder is inflamed it commonly produces pus, and this naturally finds its way into the milk. With the pus there are sure to be bacteria that are associated with inflammatory troubles. There are also, other diseases that affect both cattle and man, which are transmitted through the milk, therefore, no animals suffering from any udder affection should be allowed to furnish milk for public consumption.

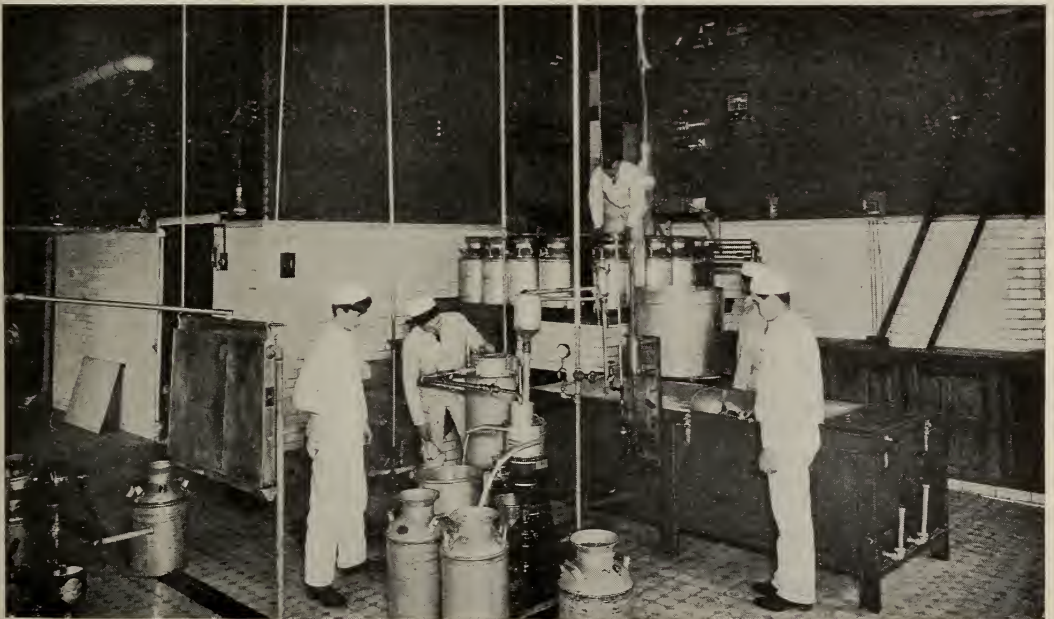
One of the chief sources of bacteria is the cow herself. She is not the source of the growth of bacteria so much as the medium of catching in her hair the dust and germs which are so easily dislodged at the slightest movement of the surface of the cow. There are probably not more than two or three kinds of bacteria which really grow and multiply on the skin of the cow. All other germs on the cow get there from the dust laden with bacteria. It is not uncommon to see cows covered with so much dust that the color of their back cannot be seen, and their flanks, hips and sides plastered with manure. When the work of cleaning the cows is neglected it is impossible to keep milk clean while milking. Large lumps of dirt, hair and straw are continually falling into the pail. As more or less motion occurs at milking the loosely adhering particles are dislodged just at a time when the milk pail is in a position to collect them.

Some idea of the number of bacteria that are likely to be brushed off the cow while milking can be obtained from the experiment of collecting the dirt curried from the cow and plated in gelatin culture media for numbers. A gram of

curry powder was tested for the number of bacteria it contained, which was found to be 207,000,000—an enormous number for so small an amount.

In order, therefore, to eliminate micro-organism from this source it may be necessary to groom the cow thoroughly or to clip the hair on her udder. If the cow is kept clean, and is thoroughly groomed, the necessity for clipping is not so great. Further, by dampening the udder during the milking process the hair and dirt may be made to adhere so that it will not fall into the milk.

It was formerly thought that the greatest source of contamination was the air, but more recent study has produced considerable change in this belief. Fresh air out in the open does not contain many bacteria, and if milking could be done in such a place this source of contamination would be almost excluded. The conditions are very different in a close barn, where the motion of the cattle stirs up the dust, and the dry feed thrown in front of the cattle spreads a large amount of dust through the stable. The common practice of keeping cattle in the same



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room where they are milked is thus very productive of a large source of air bacterial contamination. The number of bacteria from the air varies greatly with the conditions of the stable, the largest amount being immediately after feeding, especially if cows are fed on dry feed.

It is not possible to place too much stress upon the condition of the milker, for upon his individuality depends the production of pure and wholesome milk. If he is naturally clean and tidy, the milk will accordingly be as good as can be produced under conditions furnished; but if he is untidy, the milk will likewise be found dirty. The cleanliness of clothes and hands is a matter which the farmer often abhors. He finds it troublesome to put on a clean suit of clothes and wash his hands for the purpose of milking a few cows which supply his own table. Where few cows are involved, the custom may be regarded as impracticable, but where dairying is looked upon as a business and the milk and its products are sold to the public, considerations of cleanliness and care in the handling of milk cannot be despised or overlooked.

There is another aspect of the milker which deserves careful consideration. He should be a man of good health, free from any infectious disease, because it is an easy matter for a milker to transmit the germs from himself to the milk by means of his hands, clothes or various other ways. Again, the milker should never come in contact with any one suffering from an infectious disease, for he may be the means of conveying the germs and thus cause a communicable disease to spread.

Although not usually admitted, it is often the polluted condition of milking

utensils employed in the care of milk which is a great source of bacterial contamination. Bacteria are not usually killed by short periods of drying. After each milking the milking pails and other utensils are commonly washed—sometimes thoroughly washed—with hot water and soap, but no such washing will destroy the bacteria which may be in the pails. Even after ordinary washing there will be left clinging to such utensils many bacteria which are ready to develop as soon as fresh milk is added to furnish them the proper food and suitable conditions.

Water is a source of contamination too frequently overlooked. Typhoid fever as well as other diseases have been traced to water employed in the washing and rinsing of dairy utensils. Besides the harmful effects of water in the conveyance of disease, there are the numerous serious fermentations, so undesirable in the manufacture of some of the dairy products, caused by the micro-organisms found in the water supply.

The gauntlet that milk has to run from sources of bacteria is large and complex. It is not necessary for any one source to be large, but it is the total of all the sources that sum up so large a count of bacteria. It is the progressive steps, from one point to another, each source supplying its number of organisms, that produce the large totals. The diminution of the total number of bacteria depends upon the intelligent care which each source receives. The magnitude and importance of the dairy industry demands the attention and study of every citizen because the health of the community so largely depends on the character of the milk supply.

SOME MARKET GARDEN PROBLEMS

By Prof. V. H. Davis, Ohio State University

While the home gardener must accept conditions as he finds them and make the best of them, the commercial gardener must carefully select the most favorable conditions or be outstripped by his more favored competitors.

The prospective market should receive first consideration and careful study. Nearness to market will overcome many disadvantages in other respects. The man located two or three miles from market will make an enormous yearly saving over the man located six or seven miles away in the expense of hauling produce, manure and supplies and in the ease of securing labor. In case of scarcity or sudden demand for any given article, the man close at hand can more quickly throw extra amounts of this article upon the market at a good profit.

Dependence on city markets that must be reached by railroads or traction lines is not often justifiable unless other advantages are very marked. Of course, this does not apply to the crops grown at the South for Northern markets. Special locations, like summer resorts and watering places, afford the gardener with unusual market opportunities. Good, fresh vegetables of all sorts are always in demand at such places, even at excessive prices, and this demand comes in the height of the season for the gardener, when produce can be grown at the least possible cost.

Many small towns and cities of 25,000 to 100,000 inhabitants are very poorly supplied with locally grown vegetables and offer excellent opportunities to the market gardener. Local competition is usually not so sharp as in the larger cities, and most of the Southern grown produce is received from distributing

points rather than direct from the South, and the price to the consumer is such that the local grower, with his *fresh* produce, can successfully compete with the Southern producer.

The next factor to be considered is the soil. It should preferably be a warm, sandy loam and thoroughly well drained either naturally or artificially. It should be comparatively level or gently sloping to the south or southeast; reasonably fertile and free from noxious weeds. Such a soil will be "quick" and make possible the growing of early vegetables, which are always the most profitable. Of all these conditions of soil the texture is of the most importance, because most difficult to correct when faulty.

The value of a running stream or a pond or lake can hardly be over-estimated. A large and constant supply of water is absolutely necessary, and if not present naturally must be supplied by wells or cisterns. If the water supply is sufficiently abundant to permit irrigation in dry seasons, a wonderful advantage will be secured.

Insufficient capital is the most common cause of failure in commercial gardening. The small amount of capital necessary to begin farming is misleading to the beginners in gardening. Henderson, in his "Gardening for Profit," states that not less than \$300 per acre should be available in the beginning for any area less than ten acres. This seems an enormous sum, but the first season rarely pays more than current expenses, and the capital of \$300 per acre will all be absorbed in horses, wagons, tools, glass, manures and supplies of various kinds. It is easy to jump at the conclusion that if two acres can be rented for

\$75, ten is much cheaper at \$300, but nothing could be more erroneous unless the necessary capital (\$300 per acre) is available. The rental or interest on the ground used in gardening is rarely more than from 8 to 12 per cent. of the working expenses, so that an apparently cheap rent or cheap purchase does not materially affect the results if other conditions be favorable. It will always be more profitable to garden two or three acres well rather than ten acres poorly.

A market garden three or four miles from market, closely cropped and with the necessary glass, can be made to give profitable employment to about one man per acre the year round. Two strong, active horses will often be sufficient for

areas less than ten acres within two or three miles from market, but in most cases three will be more profitable, because marketing and cultivating can go on uninterrupted.

Some one has truthfully said that "manure—good manure and plenty of it—is the cornerstone of successful market gardening." While the farmer finds himself limited in the amount of manure he can profitably use upon the ordinary farm crops, the gardener, as a rule, finds that the more and better manure he uses, whether stable or commercial, the larger will be his profits. The best crops with which to use it and the most economical methods of handling must be carefully and thoroughly determined by each gar-



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dener for his own conditions. Stable manure is undoubtedly the favorite material, not only for the plant food it contains, but for its loosening and quickening effects upon the soil. There are two or three serious objections to the use of stable manures alone from year to year. In the first place, a ton of ordinary fresh stable manure contains from \$1.50 to \$2 worth of actual plant food, and the gardener cannot afford to use it except sparingly if the total cost, spread upon the land, is much in excess of these figures. In many cases distance and first cost becomes prohibitive. Stable manure, from its very nature and methods of handling, must always be a source of needs, with all their costly annoyance.

For the above reasons and others, commercial fertilizers are being largely substituted for stable manure by many gardeners. A ton of high grade fertilizer (it pays to buy no other) costs about \$50 spread upon the land. The most liberal in its use recommend 2000 pounds per acre. A fair application of stable manure would be about fifty tons per acre. This amount applied to the land would cost, in most localities, from \$100 to \$150. Most of our garden crops are nitrogen and potash feeders, and in the application of stable manures in sufficient quantities to supply these elements in proper amounts, especially nitrogen, phosphoric acid and often potash is applied beyond the needs of the crops, which, of course, is not economical. It becomes evident, then, that soils filled with humus from previous heavy applications of stable manure may have the necessary plant food much more cheaply supplied in the form of commercial fertilizers. The use of manures chiefly as a source of humus and fertilizers as the chief source of plant food will usually be

the cheapest and most satisfactory method. This is especially true if nitrogen, potash and phosphorus be bought separately and mixed at home in the desired proportions or applied separately as the growing crops demand.

One form of commercial fertilizer deserves special mention on account of its peculiar adaptability to the needs of the gardener. It is nitrate of soda. The process of rendering the nitrogen in the soil and manures available for plant growth is a slow one, especially in the early spring time. In nitrates we have just the element most needed immediately, soluble and available to the plants. By applying it in small quantities about as fast as the growing crops can use it, a vigorous growth of foliage can be stimulated at small cost, and at a time when the product will bring the most money upon the market. It should be applied at the rate of about 100 pounds per acre at intervals of about two weeks. Apply broadcast, when the foliage of the plants is perfectly dry, or just before or during a rain. The effects can be seen within a few days by the darker colored foliage and unusually thrifty growth.

In conclusion, there are frequently local sources of fertilizers that will be available to the alert gardener at a nominal cost. Wood ashes, refuse hops from the breweries, leather and bone scraps from the manufactories where leather or bone articles are made, refuse from the fillers and cleaning vats of the sugar mills, tobacco stems from cigar factories, night soil, sewage and many other things may often be secured for little more than the cost of hauling, and will go a long way toward the solving of the fertilizer problem in a satisfactory and profitable manner.

RURAL INDIA

By R. K. Dass, '11

India is about two-thirds the area of the United States, with a population of 300,000,000. On the north stand the great Himalaya ranges, with thousands of snow covered peaks, the chief of which is Mount Everest, with an elevation of over 29,000 feet. On the south lies the great Indian ocean, which, stretching out on the east and west, together with the Himalaya ranges, surrounds the whole country. Two other ranges run along the coasts of the Decau, the Southern India, while through the middle extends the Bidhya range from east to west, dividing the whole land into two natural regions.

Many rivers take their rise in the Himalayas and flow to the Indian ocean, the chief of them being the Indus on the west and the Ganges and the Brahmaputra on the east. The southern parts are watered by the rivers from the Bidhya.

Climate.—From the Himalayas the land of perpetual cold, on the north, the climate undergoes a variety of changes until it reaches Ceylon, the southernmost part, where there is practically no winter. Innumerable clouds are drifted from the Indian ocean over the plains of Bengal, the eastern India, by monsoons, which blow from the southwest from April to October and in the opposite direction for the rest of the year, making the latter one of the wettest countries in the world. In the middle lies the vast desert of Rajputana, bordered by the arid regions of upper India, with very extreme climates.

Natural Resources.—India was once very rich in her natural resources, and

now it is almost impossible to form an adequate idea of her past wealth. She has been robbed and plundered from the time of Alexander the Great until the present day. The Mogul emperors' "peacock" throne, which was decorated with pearls, rubies, sapphires etc., to resemble a peacock and which was taken away in the seventeenth century by Nadis Shah, the Persian nomad, is estimated to be worth \$16,000,000, while the "Kohinor," one of the largest and most valuable diamonds in the world, was in the possession of a Hindu prince only fifty years ago and now adorns the crowns of the king and queen of England in two separate pieces. It is estimated to be worth about \$20,000,000 and came from one of the princes of Hindustan. These are only two of the many instances of the fabulous wealth of the East Indies, which attracted the envy of all the western world in the fifteenth and sixteenth centuries.

Gold, silver and other precious metals, as well as rubies, sapphires and other precious stones and jewels, have long been known to the early Hindus.

Pearl fishing in the Falk's straits, near Ceylon, is still one of the great sources of income to the British government. Other resources now consist in iron, manganese, mica, potassium, coal, petroleum, etc.

Flora.—India is very much varied as to her flora, as might be expected from a country with so many phases of climate. Ferns, spruces, pines and other trees of sub-tropical climates are abundant in the Himalaya regions.

Cultivated plants, like apple, pear,

peach, plum, and a host of others, grow plentifully in Kashmere, the north-western part of India, where on the advent of spring the whole country is transformed into a magic land, with thousands of birds pouring forth their songs in response to the humming notes of insects hovering over the vast mass of flowers, both on land and on the "floating gardens" in the numerous lakes with which the country abounds.

In Bengal one is rather tired with the perpetual green verdure of the landscape. Fruits and flowers all follow one another in perpetual succession all the year round. Bananas, palms, cocoanuts, berries, pineapples, and other fruits of the tropics are plentiful, while one of the best fruits is found in the mango, which grows in all parts of India.

The districts of Assam produce the best oranges found anywhere in the world.

In the rainy season, which follows immediately after the summer months of June and July, Bengal is clad in one unbroken green hue. The whole country turns into a vast field of rice and jute cultivations, interspersed here and there with orchard tufts, over which the big banyans raise their heads, like towers in a castle, indicating the vicinity of Hindu villages.

Peas, beans and other legums of several varieties are among the common winter crops. Cabbages, cauliflowers, potatoes, radishes, beets and lots of other vegetables are raised all over the country.

The Indus and Gangetic valleys, with Ceylon and Burmah, are especially suitable to the cultivation of rice. The rest of the country produces very extensively wheat, corn, oats, barley and other grains.

Assam, the northeastern part of In-

dia, vies with her sister country, China, beyond the Himalayas, with her tea plantations, and, together with Ceylon, has monopolized the tea markets of England and other European countries.

Poppy crops, on which is based the inglorious opium trade of the British government with China, is largely raised in Bengal and other neighboring provinces.

Indigo, which monopolized many markets of the world until very recently, is grown in many parts of India. The southern and western parts of India are especially adapted to the cultivation of cotton, although other parts raise it more or less.

The cocoanut forms a very important crop of the Malabar coast in the south and also in Ceylon. The first thing which will come into the vision of a passenger on board the eastbound ship after leaving Aden is a long line of cocoanut trees, which form a bulwark along the coasts of that emerald island.

India also produces a very large quantity of timber in many parts of the country, especially in Assam and Burmah. There are vast forest lands teeming with tall-headed trees, the chief of which are teak and mahogany.

Fauna.—Nor is India deficient in her faunal treasury. The Himalaya regions are the natural home of a species of goats which furnish the raw material for those oriental shawls which, along with other Indian manufactures, found their way through Venice into the most fashionable markets of Europe early in the seventeenth century and attracted the notice of the whole western world.

Ivory is exported from many parts of India, especially from Assam and Burmah, where hundreds of herds of elephants still roam wild in the depths of the forests.

Sericulture is an important business in Burmah, Assam and other parts of India.

Dairy cattle received special attention by the early Hindus. The improvement in that line has been considerable in certain sections of the country and has been appreciated by other countries, especially Germany, who has imported some cattle from India.

Buffaloes and goats are also utilized for dairy purposes in many parts of India.

Tillage is done principally by oxen and buffalos, which together with camels, horses, mules and elephants, also serve as beasts of burden. Horses have been known to the Hindus for thousands of years and were first used for tillage, but now they are exclusively reserved for riding, driving and draft-ing purposes.

The number of animals—beasts and birds and others—which do not serve any special economic purpose is immensely great.

But "Nature always works in a spirit of compensation." In addition to the richness of fauna and flora, she has not failed to provide India with the dreadful malarial germs, vicious snakes and Royal Bengal tigers.

Conclusion.—India is a great agricultural country, with vast natural re-

sources. The early Hindus knew very well the importance of irrigation in agriculture. The Ganges canal, excavated more than two centuries ago, is still the largest of its kind on the face of the earth. But scientific methods of agriculture, with the modern machinery and implements, has not yet been introduced. The extreme poverty of the peasantry, who has to pay sometimes more than 80 per cent. of the yield, may be one of the causes of this backwardness. But the greatest hindrance to modern improvement is the British rule, which is not only adverse to the scientific education of the Hindus, but has both directly and indirectly checked all the important manufactures and industries of the country.

Famine, which was unknown in India before the British rule and which is carrying away thousands of lives every year, is not due to the failure of crops, as is given out to the world, but is only a natural consequence of the one hundred and fifty years' plunder of the British rule. These few lines came from the hands of an eminent Englishman, the late Mr. Digby, who was a distinguished member of the House of Commons for many years: "India is still a fair game of plunder and is plundered. The plunder is proceeding far more outrageously today than at any preceding period."

FUTURE OF THE HORSE INDUSTRY

By C. G. Fieldner, '12

Undoubtedly there is no industry whose future is so uncertain as is that of the horse. During the last fifty years certain factors have been working together which it seemed would cause the abandonment of the horse industry as a source of gain.

It was thought that the introduction of the steam railroad would be a serious menace to this industry, but it proved to be one of the greatest benefits ever conferred on it. In 1850, 2.03 per thousand of the male population of the United States were draymen, teamsters, liverymen, etc., while in 1900 the number so employed was nearly four times as large.

When, in 1885, the horse car began to be used in cities, the demand for horses was increased very much. From 1884 to 1895 there was more horse breeding than in any other decade in our history. Between 1890 and 1895 the electric car appeared. This was a hard blow to the horse industry. The supply exceeded the demand. At this time bicycles appeared, and, to cap it all, the panic of 1893 came on. With the great fall in prices caused by these three agencies, horse breeding became unprofitable and almost ceased. It was commonly predicted that horses would not be in general use much longer and that breeding could never pay in the future. But in 1898-1900 they gradually began to increase in value, until at present the average horse is worth more than it ever was before. But not only did horses increase in value in the last fifty years; they also grew in numbers. In 1850 there were about 4,337,000 horses in the United States; in 1890, 15,266,000; in 1900, 16,695,000, and today there are over 20,000,000. This growth, both in value and numbers, occurred in spite

of what seemed then as the most adverse circumstances.

In the last decade a new competitor has appeared which promises to be stronger and more destructive to the horse industry than any of its predecessors. This new rival is the automobile. The automobile ten years ago could only be had by the rich. Today it is within reach of large numbers and is used as much for business as for pleasure.

The horse which is affected most is the light draft and wagon horse. The only way in which the automobile surpasses the draft horse is when there are long hauls over level streets. For coal, breweries, etc., where there are many turns and alleys, the horse has the advantage.

The strongest competition will be with wagon horses, especially expressers and delivery horses. Here the automobile has the advantage of speed, which is, of course, the paramount thing. But whether the automobile is strong enough a factor to seriously injure the horse industry is doubtful. We have seen how the horse industry not only lived through but profited by the advent of the steam and electric car. In the last ten years since the appearance of the automobile horses have increased by nearly 4,000,000. The valuation per head has also increased.

There is a factor of recent origin which will do much toward strengthening the horse industry. That is our export trade. Europe is beginning to realize the value of the American horse. In 1891 we exported 3110 horses, while in 1901 82,250 horses were sold at foreign markets.

Neither should we overlook the fact
(Continued on page 24)

THE AGRICULTURAL STUDENT

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JUNE

EDITORIALS

It is almost unbelievable how little people not connected with the Agricultural College or agricultural work of any kind, know of what the work consists or to what it may lead. Many times we are asked, "What do you study over there?" "What will you get to do when you get through?" or "What kind of jobs can you get?" Absolute ignorance of the fact that there are experiment stations, much less, of what they are, that there is government work in agriculture and that the people spend vast funds for agricultural advancement. The people cannot make use of this sum themselves and so they hire agricultural college graduates to do this for them. The call for men in all lines is very strong this year. The graduates of the College of Agriculture go out at as high a salary as graduates from any college in the University and much higher than most of them. They do not have to wait around several months for something to do. The work is in all cases pleasant and steady employment sure. There may not be the chance for the accumulation of great wealth in agricultural work, but there is a surety of a life full of good things.

No less than fifteen highly desirable situations are now practically open to any student who feels qualified to take up the work. For example, the Summerside Poultry and Stock Farm applies for a Junior, a Senior, a graduate two-year man to take charge as superintendent of a 1000 acre stock farm. The University of Wisconsin offers two fellowships in agriculture, with \$400 a year, two more with \$225 a year. The United States government wants a number of Junior animal husbandmen at a salary of \$1260 to \$1560 per annum. The University of Idaho wants a number of professors and instructors at salaries ranging from \$1200 to \$1700 per year; an assistant professor of animal husbandry and instructor in agriculture and an assistant professor of forestry and botany. Besides this, the Thurston Teachers' Agency is applying for a large number of teachers in agriculture, agronomy, animal husbandry, bacteriology, entomology and veterinary medicine.

In the April number we called attention to the Alsdorf law, which provides for the holding of county agricultural schools during next year. The Bulletin describing this extension work is now out, and already about fifty counties have applied for schools. This indeed speaks well for the interest taken in agricultural education throughout the state. In our opinion no work of greater importance has been undertaken by the college and we look forward to a most profitable year. The schools will begin about October and plans for forty or more are being laid.

The Bulletin, Vol. XIII, No. 23, gives all information concerning the work, and any who have not seen it would do well to get one at once.

NEWS NOTES

The summer meeting of the Columbus Horticultural Society will be held at Glenmary and the forest parks in that vicinity. It is to be a field meeting, and the program gives promise of an equally interesting and profitable occasion. It is to be a nature study day. Professor Lazenby will be the leader in the study of trees, Professor Hine in the study of insects and Professor Davis in the study of weeds. Some time will be spent on the grounds of the Columbus Orchard Company.

The class in elementary forestry spent a recent Saturday on the grounds of the Boys' Industrial School near Lancaster. The object of the excursion was to learn something of the forest conditions of rough sandstone and to see what the home was doing in the way of modern forestry. The class was well received by the officials and was given every opportunity to inspect the grounds. The "school," the woodland, the scenery, to say nothing of the strenuous exercise, made it a day to be long remembered.

The apiary connected with the Department of Horticulture affords the students that are interested in bees a fine opportunity for observation and study. A number of the boys who had the course in beekeeping last year under Professor Lazenby have secured some colonies of their own and are making them a source of income as well as a means of instruction.

Variety tests of corn, wheat, oats and grass seed mixtures are being conducted in co-operation with the Ohio Experiment Station and the United States Department of Agriculture. The department is also conducting corn breed-

ing experiments and work on the improvement of clover and alfalfa by plant selection.

Assistant Professor H. C. Ramsower is spending three months in the West in the interests of the Department of Agronomy. He will spend about two weeks studying the equipment and methods of teaching agricultural engineering in each of the following states: Illinois, Wisconsin, Iowa, Missouri, Colorado and Nebraska.

The entire field east of the live stock buildings, about eight acres, is being used for plot work by the Department of Agronomy.

Arrangements have been completed for the bronze medallion portrait tablet for Townshend Hall. The tablet will be completed and in place so that it can be unveiled during commencement week. All alumni and ex-students should send their contribution to Dean Price at once, if they have not already responded to the appeal which was sent out some weeks ago. A sufficient amount has been collected to justify the committee in ordering the tablet, but it will require a liberal response to complete the fund of \$300 which is necessary to cover the entire cost.

The fruit prospects in central Ohio, judged by the orchards at the Ohio State University, are not flattering. The trees bloomed irregularly, and there were some severe storms during the blooming period. The indications at present seem to point to about one-half of a normal crop of apples, pears and cherries, while the peaches and plums will be an absolute failure. The failure seems to be due mainly to the

severe douth of last summer and fall, and the small fruits have suffered even more than those of the orchard.

J. H. Gourley and M. E. Corotis, last year's graduates in horticulture and forestry, are now connected with the experiment station at Wooster. I. S. Keil, who left the University the beginning of the spring term, is also working in the horticultural division of the same institution.

C. W. De Pue, who completes the course in horticulture and forestry this year, expects to embark in practical horticulture in Texas immediately after commencement. He goes to Falfurrias and is to be associated and engage in the same line of work as W. G. Yeager, who has met with signal success during the past year.

THE FUTURE OF THE HORSE INDUSTRY.

(Continued from page 21)

that the American horse is being gradually improved. The scrub and grade are

giving way to the blooded animal. A number of states have enacted stallion license laws, which do much toward improving the breeds. As the blooded horse properly managed is a more profitable animal than the grade, even should the number raised be less, the margin of gain will not be decreased and horse raising as an industry will remain on a firm basis.

In predicting the future of the horse industry it must be admitted that it is somewhat uncertain. The greatest competitor is the automobile. You will recall that it was thought that the steam and electric roads and the bicycle would make horse raising unprofitable. But these changes in transportation which tended to displace the horse have, on the other hand, tended to increase the use of horses for other purposes. Is not this probable in the case of the automobile? This consideration, together with our rapidly increasing foreign trade, and the gradual improvement in quality, is sufficient to warrant the stability of the horse industry for at least another generation.



CINCINNATI MILK SHOW AND DAIRY INSTITUTE

By Ivan Steiner, '08, Dairy Assistant

The Cincinnati milk show, held May 4 to 8, in the Chamber of Commerce Building, proved to be the greatest ever held in Ohio and ranked among the greatest of its kind in the United States. Three contests were held in the milk exhibit, one being a national certified milk contest, in which there were twenty-five entries. The first and second prizes were two silver cups donated by the National Certified Milk Producers' Association and the American Association of Medical Milk Commissions. These prizes are to be contested for annually, and if any producer of certified milk wins the cup three years in succession it will then become his personal property. In this contest William Lovell, of Brighton, N. Y., received the first prize, and F. E. Moore, of Alfred, Pa., the second. There were twelve other entries which received a score of 90 or above. Forty-nine entries were made in the Cincinnati market milk contest. The prizes awarded were contributed by the business men of Cincinnati. In this contest Albert Irons, of Lebanon, received the first prize, and L. C. Croppenbacher, of Bethel, O., the second. Fourteen of the entries received a score of 90 or above. In the inspected milk contest French Brothers, of Lebanon, O., received the first, and the Walker-Gordon laboratory received the second prize.

In connection with the milk exhibit the Dairy Division of the United States government displayed a complete ex-

hibit of photographs, charts, sketches, etc., showing sanitary and unsanitary methods of handling milk, and also a complete milk testing laboratory. The boards of health of various states and cities contributed sets of photographs of the dairy industry in foreign countries. Miniature models of ideal dairy barns, farms and laboratories were great object lessons to the public in the production of clean milk. At least 5000 visitors passed daily through the exhibit rooms.

The dairy institute was held May 7 and 8. The topic of the first session was "What Constitutes Good Milk? How Is It to be Produced?" W. E. Miller presided. Acting Mayor John Calvin gave the address of welcome. He told of the benefits of such an institute and exhibit to the Queen City and spoke of the opportunity to bring the producer and consumer together. The response was made by John D. Nichols, president of the Ohio State Dairymen's Association, who referred to the fact that the dairy farmer was not improving his industry as other phases of farming were being improved. He said that the dairyman must take up the work of bettering his condition, and at the same time the consuming public must be willing to pay a price for a better product.

Oscar Erf, professor of dairying of the Ohio State University, was given the subject of "Stable Construction." Professor Erf is an authority on this subject. He insists that, above all things, a dairy barn should have plenty of sunlight. "Sunlight," he said, "is the cheapest and most natural disin-

fectant. Why, then, do the dairymen not let it in?" He said that each cow should have at least four square feet of unobstructed light. By a series of charts he illustrated the proper methods of ventilating and floor construction. Dr. Lane then announced the results of the various contests.

The Friday evening session was largely for the consumer. Hon. Guy Mallon presided. Dr. Benjamin R. Hart, who has charge of the federal food and drug laboratory of Cincinnati, spoke of the investigations which had been made by the government along the line of milk. In one day out of 300 samples tested by the laboratory 186 of them were found to be adulterated, other than skimming and watering. Sixty-six per cent. was a fair average for adulterations when the laboratory was first established, but now it had dwindled down to 10 per cent. Dr. Otto P. Geier showed a series of stereopticon views of unsanitary stable conditions around Cincinnati. These were then contrasted with views of the certified dairy of Stephen Francisco, of Fairfield, N. J. Mr. Francisco was then asked to come before the audience as a pioneer in the production of certified milk. Mr. Francisco told how he came to produce certified milk. He said that no one should go into the milk business unless he wants to make it a part of his life. If he does that, he will be amply repaid. Dr. Samuel E. Allen briefly discussed "The New Health Board and Its Responsibilities" in regard to the milk supply of Cincinnati. The chief speaker of the evening was Dr. W. A. Evans, health commissioner of Chicago, on the subject "The City's Health: Its Best Asset." He said: "The health department does not bring political joy to a party, and the best thing for that party is to get it out of

politics." In certain poor districts of Chicago nine-tenths of the children born are buried while still infants. To illustrate the carelessness of the people with reference to the milk supply, he stated that it was very seldom that a woman would look over the records of a dairy from which she procured her milk. The health board of Chicago knows the condition of 12,000 dairies in four states which supply the Chicago trade.

John D. Nichols presided over the forenoon session on May 8. The main topic for discussion was "Detection and Cure of Diseases in Dairy Cattle. Effect of Cattle Diseases on Milk." Dr. Frank Eisenman, state veterinarian of Kentucky, opened the session by a discussion of "The Tuberculin Testing of Dairy Herds." In part he said: "It has been demonstrated that 45 per cent. of the children affected with tuberculosis contract the disease through the intestines, which indicates that the source of the disease is tubercular laden milk. In five years 750,000 people have succumbed to this disease, and 10 per cent. of the dairy cattle are affected with it. The annual loss to live stock in the United States amounts to \$14,000,000." Dr. H. A. Christmann, of Cincinnati, gave his personal experiences with the more common types of the diseases of the dairy cow. "Diseases of Children Traceable to Bad Milk" was the subject discussed by Dr. Alfred Friedlander, chairman of the milk commission of the Academy of Medicine. Bad milk was placed under two headings—that containing chemical adulterants and that containing pathogenic bacteria. Ninety-five per cent. of the gastro-intestinal diseases are due to bad milk. Stephen Francisco gave the audience an interesting

talk on his "Twenty Years' Experience as a Producer of Certified Milk."

The chief topic for the afternoon session was "The Breeding, Selection and Feeding of Dairy Cows." Professor Oscar Erf presided. L. P. Bailey, of Tacoma, O., discussed "The Breeding and Selection of Dairy Cows." "Breeding dairy cattle," he said, "is a complex problem, as all theories are contradicted at times by actual results. The object of the breeder is twofold—that of reproduction and the production of good producers. There are two ways by which a breeder may improve his herd. First, he must have in mind his

individual type, and, second, he must know the ancestors of his animals as far back as is possible." Bert Smith, of Delaware, O., one of Ohio's most successful dairymen, explained how to produce cheap feeds. C. S. Plumb, professor of animal husbandry of the Ohio State University, addressed the audience on "Wet Feeding versus Dry Feeding." His objection to wet feeding was not so much due to the feed itself as to the unsanitary conditions under which it was fed and which it produced in the stable. After a discussion of the above topics, the meeting adjourned.

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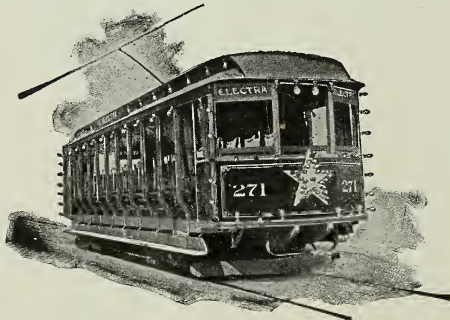
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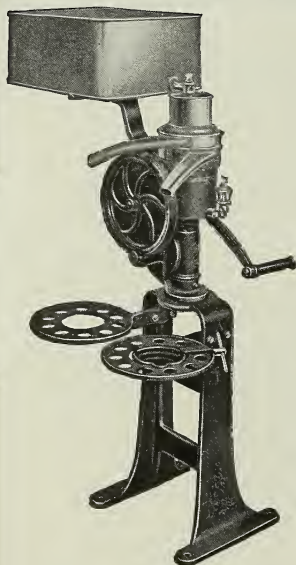
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